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ABSTRACT

One of four reports designed to assess the current state of new technologies, the document reviews the current and future 5-year status of videodisc technology in special and regular education. Described first are the history, technological features, and prices of videodisc systems (which consist of a player, programing material stored on a disc, and a video monitor or television receiver). Discussed relative to general education use are: potential applications, flexibility of systems, and five categories of use (source of teacher inservice materials, source of visual reference materials, source of instructional programing, source of presentations to supplement teacher's academic training, and part of an information storage and retrieval system); software development by seven projects of universities; and trends (such as increase in sales when the hardware/software relationship improves). Special education is seen as having an enormous potential for use of videodiscs due to capabilities for ease of use, single-concept presentation to individual students, inservice training, and information storage and retrieval. Noted are current development activities by five government sponsored projects, including the Media Development Project for the Hearing Impaired at the University of Nebraska. Among factors described as affecting use are drawbacks in current hardware technology, lack of software, and need for training teachers. The summary synthesizes content of the document and highlights current hardware/software capability and price deterrents. (MC)

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VIDEODISCS IN SPECIAL EDUCATION

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EDUCATIONTURNKEYSYSTEMS, Inc.

256 NORTH WASHINGTON STREET
FALLS CHURCH, VIRGINIA 22046

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Preface

This document is one of four reports designed to assess the current state of new technologies, review the current uses of the technologies in regular and special education, and project the manner in which these technologies will affect special education during the next five years. These reports address four very important categories of new technology: microcomputers, telecommunications, videodiscs, and communication aids.

The information presented in this report is the result of the distillation of a great deal of data from a wide variety of information sources. Foremost among these sources were:

- discussions with high-level officials from more than 60 firms which develop, produce, publish, or distribute technology hardware and software;
- responses of nearly 200 high-level LEA special education officials who attended four project technology workshops;
- information reported by such education and industry organizations as TALMIS, Knowledge Industry Publications, the National Audio Visual Association (Materials Council), the National Association of State Directors of Special Education, the TRACE Center, and the Society for Applied Learning Technology;
- Federal reports sponsored by the National Science Foundation, the National Center for Education Statistics, the Office of Technology Assessment, ED/Division of Education Technology, and ED/Special Education Programs (SEP); and
- independent research studies and surveys.

In addition to these project sources, Education TURNKEY Systems staff has conducted workshops on technology applications in special eduction for more than 4,500 state and local special education administrators.

The trends, estimates, and projections contained in this report have been derived from many sources and represent the best estimates of Education TURNKEY Systems and The Futures Group.

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VIDEODISCS IN SPECIAL EDUCATION

Current videodisc systems are being promoted primarily as a new entertainment technology. But such systems, with their storage capacity and flexibility, offer great potential in the areas of training and education. This document describes the videodisc technology and discusses the potential applications of videodiscs now and for the next five years.

I. THE TECHNOLOGY

A videodisc system, like the traditional audio stereo system, consists of a player, programming material recorded on a disc, and an output device ... in this case, a video monitor or television receiver. In this document, the term "videodisc" is generally used to define the system (i.e., player, monitor, and discs). "Intelligent" videodisc is a term used to describe a videodisc system that has an attached microcomputer. Intelligent videodiscs are capable of accepting input from the user and performing the branching and interactive functions which are important elements in the educational use of videodiscs. Interactive videodiscs are intelligent videodisc systems in which the user interacts with the system (beyond merely turning it on and off).

The videodisc was first introduced commercially in Germany in 1975. At that time, companies in Japan and the United States were developing their own videodisc technology and subsequently made their videodisc systems available for purchase. By 1979, a number of different brands of videodisc players and videodiscs were being sold throughout the U. S. with national advertising campaigns highlighting the technology as a new entertainment medium.

The videodisc itself is similar in size to a long-playing phonograph record and can hold the equivalent of 54,000 still photographs or as many as 60 minutes of motion picture film per side. Two channels for sound can be used to provide stereo or separate presentation material, depending upon which channel is selected for play. There are two popular disc formats; these are not

compatible with each other and require very different types of videodisc player units to transfer the information from the disc to the television screen.

The capacitance system, employed by RCA and JVC, encodes information on the disc in the form of pits. The capacitance player unit employs a stylus which rides on the surface of the disc and picks the information off the disc by detecting capacitance variations between it and the disc surface. The capacitance player units which are currently available have such basic features as start/stop, fast/slow, and forward/reverse. These player units cost about $400 with the stylus requiring replacement after a certain number of hours of use (i.e., 200 to 2,000 depending on brand).

The optical or laser system, used by Magnavox, Sony, and Pioneer, also encodes information on the disc in the form of pits (smaller than the capacitance disc pits). The disc is then given a silver reflective coating which provides the characteristic rainbow appearance when held near a bright light. The optical player unit employs a miniature laser to pick the information off the disc. The laser beam is focused on the disc surface and reflected back to a decoding unit by the silver coated pits which represent the recorded information. The optical player units currently available have features which include those available in the capacitance system (start/stop, fast/slow, forward/reverse) plus the additional features of still frame, frame-by-frame, and random access. The optical disc never wears out and the laser lasts about 10,000 hours before replacement is needed. These player units can be purchased at a starting cost of around $500 for "consumer" models. "Industrial" models, with sturdier components, more features, and a small on-board microcomputer, cost around $3,000.

Unlike videotape systems, commercially available videodisc systems cannot record programming material. Once equipment is in place and the first "master" disc is prepared, the production of discs is generally an inexpensive process (given certain minimum disc quantities). The mastering process is, however, quite expensive -- although the cost has come down markedly in the last year. Industry is currently developing the write and read capability needed for the effective use of videodiscs as a storage medium. A videodisc filing system

marketed by Toshiba stores 10,000 pages of material on a single-sided videodisc for hard copy recall at any time. Within ten years videodisc information storage may seriously challenge microfilm, especially in the area of remote access.

Videodisc technology is advancing at a rapid rate. New products with improved features are being introduced almost on a monthly basis. For example, the newly available Optical Memory Disc Reader (OMDR) is a laser system which allows the user to record moving or still pictures directly onto an optical disc. OMDR discs are about two-thirds of the size of standard discs and will hold the equivalent of 15,400 still frames on one side. A blank disc costs about $750 and can be used for recording only once. The OMDR recorder/player unit costs about $3,500 and, in the playback mode, can access any frame on the disc in about half a second. The standard OMDR unit operates in black and white using a digital recording format. Color and other options are expected to be available soon.

II. GENERAL EDUCATION USE

The videodisc player offers many potential educational applications through its capability to present both moving and still pictures on the same disc. However, the acceptance of the videodisc by school staff has been slow and cautious. As happened with electronic calculators and microcomputers, science and mathematics departments have been quick to support new technology issues; these educators view the videodisc as another technological advancement to bring into the classroom.

Inherent flexibility of optical/laser videodisc systems makes them more suited to education applications than capacitance systems. Some optical players contain a limited-memory microprocessor which allows the user to select material on the disc for presentation in a particular sequence and duration and to program this into the player memory. This material sequencing capability can be greatly enhanced by connecting the optical videodisc player to a microcomputer, making it an "intelligent" videodisc system. With the additional programming the diskette storage capabilities of the microcomputer,

the videodisc user can prepare an instructional sequence which includes: (a) presentation of selected information from the videodisc; (b) presentation of questions and additional information by the computer; (c) determination of correctness of answers typed in at the microcomputer keyboard; (d) branching to appropriate information on the videodisc; (e) pacing according to the user's information acceptance rate; and (f) recording the user's performance during the presentation on a microcomputer diskette. This capacity for coordination between user and system makes such a device an "interactive" videodisc.

A. CATEGORIES OF USE

Because videodisc use in education is in its infancy, very little practical experience has been gained in educational videodisc applications. Experience in nonschool environments and knowledge of the capabilities of the technology make it possible to suggest a number of areas in which videodiscs could play important roles in education. Because of its flexibility and ease of operation by the nontechnology oriented teacher, a videodisc system can be used as a: (1) source of visual reference materials; (2) source of teacher in-service materials; (3) source of instructional programming; (4) source of presentations to supplement teacher's academic training; and (5) as part of an information storage and retrieval system.

1. Visual Reference Materials

Each videodisc can contain up to about 54,000 still photographs; any one of these can be accessed by a user within two to five seconds (depending on player quality) and displayed on the television screen. A single videodisc could contain enough displays to meet the requirements of just about any subject matter area ... from alphabets to puzzles; from maps of countries to geometric figures; from flags of different nations to pictures of national historical sites. The user would key-in the frame number for the particular picture desired and the videodisc player would show it on the television screen almost immediately.

Short motion picture segments of various instructional activities (e.g., the painting of a picture, historical review of a major city, a boy jumping the high hurdles, a hand forming letters used in signing, the keys of a typewritter striking the paper) could be selected from a single videodisc by the user. With a videodisc, these films can be slowed down, to observe the action better, or a single frame can be frozen to examine detail. The film can also be speeded up and be made to move forward or reverse. The user can command the player to keep repeating the film clip so that the action seems continuous for an indefinite period of time.

2. Teacher Training Materials

In-service material can be included on a videodisc to demonstrate the proper use of standardized instructional materials, especially for the special education population. Instructions and preferred procedures for administering reading or mathematics programs, teaching the alphabet, signing, and similar types of instructional activity could all be included on one disc. A media and materials development disc could focus upon the local production of certain types of instructional materials.

A videodisc that contains student instructional programs and related activities could also contain separate material for the teacher on its effective utilization. This procedure could employ a separate narrative on one of the two audio tracks which is accessible only to the teacher.

3. Instructional Programming

A large number of single-concept presentations can be included on an individual disc for presentation in almost any subject matter area. The concept can be presented repeatedly for reinforcement during class time, it can be presented by the teacher providing individualized help after school, or the pupil can operate the player at a time that is convenient to review the concept on an individual basis.

The interactive videodisc is ideally suited to the requiements of instructional programming for pupil presentation. For an entire classroom, a small group, or for an individual pupil, individualized instructional programs of short duration can be presented. They could provide for the presentation of a single concept, reinforcement through examples, and conclude with a short test. Branching to higher or lower levels of difficulty can be accommodated as well as repeating certain sections where a pupil experiences difficulty. The interactive mode represents a higher technological application of the videodisc in that the same disc can perform differently for any number of teachers or classroom situations.

4. Teacher Continuing Education

A single videodisc could p.esent materials for teachers desiring to study course material for continuing education credit toward maintaining certification. These discs could be developed by state education agencies on topics they deem most important to the needs of their state; or they could be developed by the local university as a part of its continuing education program. The teachers could view the discs in their own classroom after school hours or play them on their own players in their home.

Degree-granting institutions could prepare videodiscs containing a complete lecture series for graduate credit toward an advanced degree. The disc programming could also provide for review quizzes and practice examinations.

5. Information Storage and Retrieval

Optical disc systems have a "still picture" capability which is compatible with information storage applications -- high capacity, low storage cost, and rapid access. Information storage and retrieval on videodiscs has great appeal in education. Selected books and related materials found in libraries could be stored on videodiscs. Instead of purchasing actual reference sets and books, school building could have a small number of discs which are the equivalent to a large high school library. The savings in physical plant space alone makes

this application an attractive feature. For this type of use to be practical, complex copyright issues must be addressed by publishers.

Storage of pupil and administrative data in most school systems is now accomplished with a mass of filing cabinets, a data processing center, or combinations of these. All pupil and administrative data in the largest school district could be stored on just several videodiscs -- a tremendous savings in equipment costs and physical space requirements.

B. SOFTWARE DEVELOPMENT

There is little specially prepared material currently available for applications of videodisc systems in the K-12 educational setting. Videodisc players currently being purchased by school systems are being used primarily for entertainment programming. They are being used to show excerpts from symphonic presentations to music students, museum paintings to art students, sports presentations to local teams in training, drama and performing arts presentations to special interest groups, and movies at recess on rainy days.

A recent production entitled "KIDISC" has been well received because it was especially designed to take advantage of optical or laser disc player features like random access and stop-frame. It contains educational material and games suitable for use in the classroom and in the home.

A promising effort was undertaken by the National Foundation for the Improvement of Education/NEA, Prime Time School Television, and ABC to produce a series entitled "SchoolDisc". Initially intended for regular education teachers, the several discs were to include academic curriculum materials and teacher guide materials for use as a supplement to current local curriculum content. This project, however, has been halted because of funding uncertainties.

Several development projects have demonstrated the successful application of videodisc technology in an educational setting. WICAT, Inc. has been involved in videodisc development for a number of years. WICAT, with funding

from McGraw-Hill and the National Science Foundation, has designed, developed, demonstrated, and evaluated an intelligent videodisc biology program with student interactive capability. WICAT has conducted a number of other videodisc training projects for a number of agencies including the Defense Department.

Brigham Young University, in conjunction with the TICCIT CAI system, did some research on the use of intelligent videodiscs. They also utilized the dual audio track capability of the videodisc to develop a Spanish/English instructional program.

The Nebraska Videodisc Design/Production Group, supported by SEP and the Corporation for Public Broadcasting, has designed and produced videodiscs for a wide range of educational applications and done research on videodisc production methods. Among their educational activities are: (1) design and programming a variety of video games and a teacher management system using an intelligent videodisc for the Bilingual Childrens Television, Inc.; (2) assistance to the Minnesota Educational Computing Consortium on a production entitled "Introduction to Economics" to be used with an Apple II and Pioneer Player; (3) interactive instructional videodisc on the Tacoma Narrows Bridge collapse which utilizes the programming and storage capacity of a commercially available stand-alone player; and (4) a number of commercial productions including "Medical Education" and "Flight Training", which can be used by physicians and pre-flight training instructors, respectively.

Utah State University has been a leader in the development of educational applications of videodisc technology. In 1979, Utah State developed an experimental instructional videodisc covering a wide range of subjects. Utah state also designed an intelligent videodisc system for teaching how to use library card catalogs.

Other developmental efforts in university labs with government and private funding have produced a limited quantity of videodisc titles for educational applications. Most of these efforts were intended to demonstrate that a particular instructional sequence could be presented more completely using

videodisc technology. The National Geographic Society has produced a demonstration disc on whales with the Nebraska Videodisc Design/Production Group, but commercial sales are not planned at this time. Several commercial firms have just begun to produce and sell limited videodisc titles suitable for classroom instruction applications, but the costs are in excess of $100 per disc.

C. TRENDS

Industry estimates indicates that in 1982 fewer than 200,000 videodisc players were sold in the United States. Most of these were capacitance-type players targeted for the home entertainment market. A steady growth in videodisc sales is predicted for the next ten years with annual sales reaching one million by 1992. It is estimated that only about 100,000 optical videodisc systems have been sold to date with most going to industry for training purposes. About 250,000 optical players are expected to be in use by 1986.

Data is scarce on the number of videodisc systems being used in education. Estimates range from 150 to 1,200 videodisc players in all classrooms in the United States. Although growth in educational use of videodisc technology is certain to occur, it is unlikely that videodiscs will become a major force in education in the next five years. It will take videodiscs a number of years before they will be able to compete on equal terms with videotape systems, which currently have two advantages over videodiscs: (1) they readily record program material; and (2) they have a substantial head start as measured by the amount of hardware and software currently available in schools. Interpolation of industry data suggest that perhaps as many as 10,000 units will be in use in the schools five years hence.

Videodisc utilization in education is now at a very awkward stage. LEAs are reluctant to invest in videodisc hardware because not enough quality educational software exists to make the equipment cost-effective. Conversely, software is not being developed because of the inadequate existing hardware base. History indicates that it will take a few years (probably more than

five) of modest sales increases before the symbiotic hardware/software relationship will cause a dramatic increase in education sales.

III. SPECIAL EDUCATION USE

Although the five-year forecast for videodisc use in education is not large, research indicates that special education is an area with enormous potential for beneficial videodisc utilization.

A. POTENTIAL BENEFITS

Videodisc technology offers to the special educator a number of benefits over alternative modes of audiovisual presentation. User requirements for operation of a videodisc player are relatively simple. In fact, the videodisc player is one of the easier machines to use in an educational application. There are fewer steps in setting up the machine than found in VCRs or microcomputers. The videodisc player requires only one person to set-up, operate, and take-down. This is of special utility in an educational setting because it does not distract from the learning activity taking place in the classroom. Indeed, the teacher has merely to turn on the machine and the television, insert the disc, and press the "play" button. The videodisc player could easily be situated on the same cart or stand which supports the television in the classroom.

Virtually no unique skills are needed in order to operate the videodisc player. Preparation of the lesson plan so that it can accommodate the planned presentation on the videodisc requires the greatest attention. If the teacher planning to use the videodisc presentation is going to use it in the interactive mode, then additional planning time would be required to program the microprocessor. This activity is also quite simple as the procedures are no more complex than using a remote channel selector on an ordinary television set.

Special education instruction requires the presentation of material which is highly individualized for specific pupils; the videodisc can provide

single-concept presentations to individual pupils on a cost-effective basis. Many examples appropriate to a particular learning situation can be presented to students using videodiscs which contain a combination of instructional programming, visual references, and self-test material.

In-service training required for special education teachers can be presented on videodiscs in a most effective manner. This specific type of training to a limited audience within a school district lends itself well to inclusion in a videodisc format. The same is true for higher education academic presentation for advanced degree work or general certification in the special education area.

Information storage and retrieval in special education tends to be more complex because of laws directed specifically at the administration of special education programs at the local level. Videodisc technology has potential to provide a simple and inexpensive means to store and retrieve individual pupil records and total program administrative data.

A survey of special education teachers taken a few years ago found that, for every teacher using videotapes, four more felt that videotapes were the preferred media format for their use. This is evidence that special education teachers perceive the need for new media formats and manipulative approaches -- needs which can be well met by videodiscs.

B. DEVELOPMENT ACTIVITY

A number of recent development projects have addressed special education applications of videodisc technology. Supported by SEP, Utah State University has undertaken several projects which involve interactive videodisc development for special education applications. One such project focuses on development of a microcomputer/videodisc mathematics instructional management system for mildly mentally retarded and learning disabled children. A second project provides for the development and field-testing of a microcomputer/videodisc based social skills curriculum for severely emotionally disturbed children. Another project at Utah State calls for the development of a

microcomputer/videodisc aided bilingual mathematics assessment system for the mildly handicapped.

The Media Development Project for the Hearing Impaired at the University of Nebraska, funded by SEP, has developed a series of videodisc programs to explore the videodisc's potential for the education of hearing impaired students at the secondary level. Among their efforts was an interactive program for an intelligent videodisc which is designed to develop independent thinking skills in hearing impaired students.

When and if the aforementioned "SchoolDisc" becomes available, much of the program material, when used in an interactive mode, will be well suited for use with special education students.

IV. FACTORS AFFECTING USE

The key factors affecting LEA utilization of videodisc technology are largely exogenous to LEAs themselves: hardware advances and software availability. Of less concern, but still important, are the training needs of LEA staff.

A. ADVANCES IN HARDWARE TECHNOLOGY

A critical factor in the success of videodisc technology as an educational tool will be the development of a commercially feasible recording capability. The current high costs of mastering and producing videodisc software make impractical the creation of teacher-generated materials. The Optical Memory Disc Reader (OMDR), described above, is a useful first step in this direction. The OMDR does have a recording capability but currently has a number of drawbacks: (1) it is expensive, the recorder/player costing about $3,500 and blank discs costing around $750; (2) it does not have full color capability; (3) it is not compatible with other optical videodisc systems; and (4) each disc can be used for recording only one time. As these drawbacks are resolved, videodiscs will begin to have all the capabilities of videotape technology plus the added random access capacity videotapes do not have.

Information storage and retrieval capabilities of videodiscs are expected to improve as videodisc technology approaches microfilm and microfiche in cost and flexibility. New videodisc filing systems will allow prompt and efficient retrieval, in print form, of stored documents.

B. SOFTWARE AVAILABILITY

As alluded to above, the availability of videodisc software is perhaps the most important factor affecting the educational use of videodisc technology. Currently, schools are not purchasing videodiscs because there is so little quality educational programming available; and videodisc software producers are, in general, not willing to invest in educational videodisc software because of the meager base of hardware existing in the schools. Some of the videodisc development work sponsored by SEP and other Federal agencies may, in time, alleviate this paradox. It should be noted that the situation facing videodisc technology is not greatly different from that faced, at their inception, by other technologies which require both hardware and software to operate effectively; radio, television, audio record players, stereo systems, and microcomputers have all overcome many of the same problems seen today in videodisc technology.

Education in general needs a greater variety of programs for videodisc systems if they are to be acceepted and used as a new media. Special education, particularly, requires unique types of materials, formats, sequencing, etc. for classroom instruction. It should be noted, however, that good quality regular education disc program material could (if it were available) usually be adapted, with minimal effort, to special education needs through the interactive mode using the microcomputer as a reprogramming device. Such adaptation may, of course, raise a number of copyright and protection issues.

C. TRAINING

Operation of a standard videodisc system is quite simple. Videodisc users should require no detailed training in machine operation. More critical will be training inthe integration of videodiscs into the instructional process and the use of the videodisc's interactive capabilities. It may take a great deal of training and hands-on experience before teacheers will be able to realize fully the potential benefits of the branching, sequencing, and random access capacities built into interactive videodisc systems. Using the intelligent (optical) videodisc's random access characteristics, teachers can design presentations to suit the interests and abilities of their students without having to develop new materials. Training will be necessary if teachers are to develop these videodisc instructional design skills.

As hardware developments make such teacher programming feasible, teachers will need training in the design and production of videodisc programming. Videodisc technology offers great flexibility in presentations (e.g., combinations of moving and still pictures). Teachers will need training so that they may effectively utilize this flexibility.

V. SUMMARY

For the education user, videodisc systems (particularly intelligent videodiscs) offer several useful capabilities, including random access of information, flexible sequencing of materials, and branching to meet individual student requirements. At the same time, videodisc systems carry certain drawbacks, including high cost, paucity of software, and lack of an available recording capacity.

Videodisc technology will, in the coming years, command an increasing share of the nation's home entertainment market. The use of videodiscs in education generally, and in particular special education, will also increase although constrained by the limited availability of appropriate videodisc programming. Videodiscs in education offer a number of potential useful applications including: (a) visual reference materials; (b) teacher in-service

materials; (c) instructional programming; (d) teacher continuing education; and (e) information storage and retrieval.

It is estimated that fewer than 1,000 videodisc players are currently in use in America's schools and that most of these are being used in ways which do not fully utilize the technology's capabilities. A number of organizations, most with Federal funds, have been or are now developing educational applications for videodiscs. A substantial amount of this development work has been directed at special education applications.

In the coming years, the use of videodisc technology in regular and special education will depend on such noneducational factors as advances hardware technology (e.g., development of a practical recording capability) and increased availability of quality educational programming. As videodisc utilization in schools becomes more widespread, school staff, particularly teachers, will be required to develop new skills in order that they may make efficient use of the videodisc's capacities.

It is expected that videodiscs will, in time, become an integral part of public education's media program. It is likely, however, that it will take more than five years for this to occur.